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Regional UNIDO/ESCAP Workshop and
National Consultations on the
Commercialization of Research
Results

Bangkok, Thailand, 15-19 October 1984

DRAFT REPORT *

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I. CONCLUSIONS AND RECOMMENDATIONS

1. The Workshop had the opportunity to discuss in detail problems regarding transfer of R&D* results to users, mainly small and medium scale industries, in developing countries of ESCAP region. The Workshop strongly believed that the establishment of network among the R&D institutions, link and promotional organizations, trade and industry associations, small and medium scale industries, with a catalytic role from organizations like UNIDO/INTIB, would greatly increase flows of R&D results to users. Link organizations such as technology transfer corporations, design, engineering and consultancy companies, development banks, financial institutions, venture capital companies and small industry service institutions could play an important role in this process.

2. The Workshop while reviewing the activities of the earlier network felt that the network activities could be made more meaningful to countries of the region and to the network members themselves if some relevant policy and institutional initiatives were taken in countries such as establishment of a research enquiry service, industry enquiry service, publication of R&D newsletter, etc.

3. The Workshop felt that pending any new national initiatives much could be done by R&D institutions, industry associations, chambers of commerce, link and promotional organizations and development banks under existing policies and guidelines for promoting increased flow of R&D results to users.

4. The Workshop made the following recommendations:

(i) <u>at the institutional level</u>

(a) R&D institutions were requested to establish strong linkages with users of R&D results. For this purpose an in-house liaison unit should be set up.

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* Research and Development

(b) Research institutions were requested to strengthen their linkages with United Nations organizations like UNIDO/INTIB, ESCAP/RCTT, etc. and external data bases.

(c) Research organizations could explore the possibility of carrying out joint R&D projects involving institutions in the country and outside.

(d) For effective transfer of technology to users, there was need for trained manpower for which special steps should be taken.

(e) Every R&D organization was requested to establish an in-house group for evaluating R&D results before they were made available to industry.

(ii) <u>at the industry level</u>

(a) Industry was requested to establish close links with R&D institutions by utilizing their facilities for testing, standardization, trouble shooting, preparation of feasibility reports, carrying out market surveys and doing research and development work, etc.

(b) Industry was requested to sponsor projects in R&D institutions.

(c) Industry was requested that for promoting technology transfer from R&D institutions to them, they should provide funds/facilities to R+D institutions for establishing pilot plants and for making prototypes.

(iii) <u>at the national level</u>

(a) The Workshop believed that the national technological policies should be directed towards maximum utilization of endogenous capabilities.

(b) Countries should provide incentives to developers and users of R&D results from within the country and other developing countries.

(c) National fiscal policy should encourage in-house R&D activities by industry through measures such as tax incentives, exemption of custom duties and other taxes to facilitate import of R&D equipment, raw materials, chemicals, etc.

(d) The national policy should aim at reducing risks to entrepreneurs who wanted to establish industry based upon endogenous R&D results.

(e) To ensure availability of risk capital, venture capital companies should be set up to finance establishment of industry based on endogenous R+D work. Links between R&D organizations, venture capital companies and financial institutions should be institutionalized.

(f) Each country should establish a mechanism to evaluate and screen technologies to be imported into the country. Such a mechanism should provide for representation from R+D institutions.

(g) At the national level there should be a monitoring mechanism for ensuring proper flow of R&D results to the users by eliminating any obstacles for such a process.

(iv) <u>at the international level</u>

(a) UNIDO/ESCAP should play an important role in commercialization of research results of IRSIs by:

- encouraging regular contacts between IRSIs in the region,
- arranging at regular intervals similar workshops as the present one,

- helping member countries to carry out regional co-operative research programmes,
- preparing, in collaboration with other international organizations, a guideline on experiences in the commercialization of research results,
- assisting member countries in setting up networks, information systems, training programmes, evolving R&D policies, mechanisms for financing the commercialization of research results and linkages between IRSIs in developing and advanced countries.

(b) The Workshop emphasized the importance of co-operation between countries, and of R&D institutions within these countries for carrying out joint programmes. This would enhance the flow of R&D information and stimulate commercialization of R&D results both nationally and internationally.

(c) The Workshop recommended that UNIDO/INTIB equip themselves to play a more active role in the promotion of increased flow of R&D results to users by strengthening its relationship with producers and users of R&D results, link organizations, promotional agencies, development banks, financial institutions, venture capital companies, etc. These objectives could be achieved by establishing sub-regional and regional R&D information networks, sub-regional and regional small and medium scale industry information networks, linkages with existing data bases, organizing R+D enquiry service, industry enquiry service and training programmes.

(d) The Workshop decided to establish a network amongst the R&D institutions in developing countries of the ESCAP region with the specific objective of promoting exchange of information of R&D activities and for promoting increased flow of R&D results to small and medium scale industries in developing countries of the region. Membership of the Network is open to all developing countries in the region. India, Indonesia, Republic of Korea, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka and Thailand expressed their interest to join the networks. Governments of the countries were requested to name R+D institutions and central organizations who would work in the network.

UNIDO/INTIB was requested to vigorously pursue this matter with concerned governments/institutions to promote activities of the network.

UNIDO/INTIB was also requested to initiate action and establish a network for small and medium scale industries and link it up with the network of R&D institutions.

UNIDO/INTIB was requested to establish a monitoring mechanism to see that Network activities proceed as intended by members.

(e) The Workshop recommended that UNIDO organize the following studies:

- policy and institutional arrangements that had led to successful transfer of R&D results to industry - examples: India and Republic of Korea,
- possibility of implementing joint projects involving R&D institutions from developing countries in the ESCAP region,

5. The Workshop requested the participants to inform their governments about the deliberations of the Workshop and the recommendations for early implementation.

The Workshop drew attention of the Governments to the Vienna Programme of Action adopted at the United Nations Conference on Science and Technology for Development in 1979 and the ESCAP Plan of Action on Technology for Development approved by the member countries at the fortieth session in Tokyo in 1984 in order that the countries could implement the recommendations made at the Workshop.

ACKNOWLEDGEMENT

6. The participants in the Workshop expressed their deep appreciation to UNIDO/ESCAP for organizing this timely Workshop. They expressed their heartfelt gratitude to the Ministry of Science, Technology and Energy, Government of Thailand, and the Thailand Institute for Scientific and Technological Research for providing excellent host facilities and for arranging a visit to TISTR.

II. INTRODUCTION

A: Background Information

7. The Vienna Programme of Action which emerged out of the United Nations Conference on Science and Technology for Development held in 1979 emphasized the importance of strengthening national technological capabilities of developing countries. For achieving this objective UNIDO has been implementing a number of programmes and projects. An important activity that can contribute significantly to strengthening of national capabilities is successful commercialization of R&D results produced by endogenous institutions in developing countries. A number of industrial research and service institutes (IRSIs) had been functioning in most developing countries of ESCAP region. An important problem they have been facing was very little commercialization of their researches. This meant sub-optimal use of infrastructures already established in these countries by way of R&D institutions and trained manpower, expending scarce national resources. Local and small-scale industries had not been receiving the kind of assistance from these institutions as was expected at the time of their establishment. The weaknesses in IRSIs in developing countries had been lack of effective and appropriate industrial linkages and technology transfer activities, knowledge of industrial problems, needs of industry and what services they could effectively render to industry in the small and medium-scale sectors, the potential user of R&D results. In the light of the above it was decided that UNIDO in collaboration with ESCAP organize a Workshop and National Consultation for the benefit of developing countries in the ESCAP region. The Thailand Institute of Scientific and Technological Research (TISTR) offered to provide host facilities for this Workshop.

B: Objectives

8. The purpose of the Workshop was to bring together senior officials from selected member countries of ESCAP region who have had the experience of making policies and implementing them and directors of R&D institutions responsible for development of endogenous technologies and their transfer to users. The aim of the Workshop was to provide an opportunity for policy makers and implementators of these policies and managers of R&D institutions to exchange their experience regarding commercialization of R&D results. It was envisaged that discussions at the Workshop could assist developing countries of the region in strengthening their capabilities for more effective utilization of research results by adoption of appropriate national policies and implementing those policies for better utilization of R&D results. The Workshop envisaged, that for effective transfer of the research results to users, there was need for establishment of networks among the R&D institutions and the users and link-up of the two networks and involvement of UNIDO/INTIB as a catalyst for promoting increased use of R&D results.

C: Organization

9. The Workshop was held in Bangkok, Thailand, 15-19 October 1984 with host facilities provided by TISTR. The Workshop was attended by 35 representatives from India, Indonesia, Republic of Korea, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka and Thailand. Representatives from ESCAP, UNIDO and UNDP were represented at the Workshop. The list of participants is at Annex-II.

10. On behalf of the host organization, Dr. Santhad Rojanasoonthon, Deputy Governor, Thailand Institute of Scientific and Technological Research (TISTR), welcomed the participants and others to the inaugural function. In his welcoming address, Dr. Santhad mentioned about the timeliness and importance of the Workshop and how happy they were to be hosts for such an important Workshop. He expressed the hope that the Workshop would provide the opportunity for exchange of experiences among senior officials involved in the development and transfer of technology in developing countries of the region. This would directly contribute to more effective transfer of R&D results to industry.

11. Dr. V.J. Ram, Chief, ESCAP/UNIDO Division of Industry, Human Settlements and Technology, on behalf of the Executive Secretary of ESCAP, described the ESCAP Plan of Action on Technology for Development which was the follow-up of the Vienna Programme of Action and was adopted at the fortieth session of the ESCAP Commission held in Tokyo during April 1984. He enumerated various reasons for sub-optimal utilization of capabilities of the R&D institutions in developing countries of the region for promoting development and stressed on the need for better management of available infrastructure facilities for promoting greater transfer of technology to users.

12. Mr. M.A. Siddiqui, Special Representative of the Executive Director of UNIDO to ESCAP, mentioned about UNIDO's programmes for promoting commercialization of research results, which was a complex process. There was thus need for exchange of real experiences in this field so that this process could be understood and implemented for more successful transfer of R&D results to users. He offered the the services of UNIDO for effective implementation of the programmes and activities which might be suggested at the Workshop.

13. On behalf of UNDP, Ms. S. Natsume, welcomed the participants and wished the Workshop every success.

14. Mr. Kasem Sanidvongs, Deputy Permanent Secretary, Ministry of Science, Technology and Energy, Government of Thailand, inaugurated the Workshop. In his inaugural address, Mr. Kasem indicated the various stages that were involved in the production and transfer of research results and their successful use by industry. He mentioned about the inadequate appreciation in developing countries of the pitfalls and difficulties involved in successful transfer of technology to users. He mentioned that in many developing countries R&D activities were basically government supported with very little involvement of industry. He, therefore, emphasized the need for involvement of industry in the activities of R&D institutions. He outlined the requirements for the successful undertaking of R&D projects. He expressed his appreciation of the fact that UNIDO/ESCAP were organizing this Workshop in Bangkok. The Government of Thailand wished to extend full support to the successful completion of this Workshop with practical recommendations for implementation by developing countries of the region.

Election of officers

15. The Workshop elected the following officers for the conduct of its proceedings:

Dr. Santhad Rojanasoonthon (Thailand) - Chairman

Dr. H.R. Bhojwani (India) - Rapporteur

16. The Workshop decided to have discussions on the main topics in two groups with the Plenary Session to discuss the findings of both the Groups. Group I would work on national technology policies regarding commercialization of research results and Group II would work on linkages between IRSIs and industry.

D: REPORT

17. Discussions were continued in two groups. Group I dealt with "National technological policies regarding commercialization of research results" and Group II, "Linkages between IRSIs and industry".

18. After deliberation, the Groups submitted reports to the plenary session. The Group reports were discussed at the plenary sessions and formed the basis for conclusions and recommendations of the Workshop.

19. In the plenary session participants said that more initiatives were needed at the institutional, national and global levels for accelerating the flow of R&D results to the users. The members felt that UN organizations like UNIDO had an important role in promoting this flow. They requested the UNIDO/ESCAP to take immediate initiatives to complete all necessary activities for the functioning of the Network, formation of the Network of user organizations viz. small and medium scale industries and link the two networks, one of R&D institutions and the other of users.

20. The Report was adopted at the concluding session of the Workshop on 19 October 1984.

21. The Workshop adopted the agenda as given at Annex-I. In this connection, a representative of UNIDO introduced briefly the two UNIDO background/issue papers for discussions by Groups I and II.

III. SUMMARY OF CONSULTANTS' PAPERS

22. Dr. C.V.S. Ratnam, UNIDO Consultant, presented the two UNIDO background and issue papers - one prepared by him and the other by Dr. Neville Woodward, who could not participate in the Workshop.

23. In his paper Dr. Woodward traced the history of the establishment of industrial research and service institutes (IRSIs) in developing countries and noted the unsatisfactory status with regard to the commercialization of R&D results. The reasons for this were primarily lack of focus in R&D projects undertaken, very little or non-existent linkages with users, inherent limitation in the organizational structures of these organizations, lack of credibility and acceptability of research findings by prospective users, unreasonable expectation from industry regarding what IRSIs could deliver, preference for imported technology and lack of policy infrastructure for promoting local development and transfer of technologies. The paper described steps needed to be taken by IRSIs for successful transfer of research to industry. They were: IRSIs must be industry-oriented, must conduct their activities in a businesslike manner and their work should be based on needs of industry. As far as possible, IRSIs must find an industry partner before R&D is started and they must also evaluate projects at periodical intervals.

24. The paper described the functioning of some national research and development corporations - NRDC of U.K., NRDC of India, Research and Development Corporations of Japan, Korean Technology Advancement Corporation (K-TAC) and Indonesian Agency for Assessment and Application of Technology (BPPT). The role of consulting engineering firms and ventured capital companies in the successful transfer of research results

to industry was discussed. The services that could be given by IRSIs to small- and medium-scale industries in terms of technological information, providing market surveys, estimation of capital outlays and running costs, identification of appropriate engineering consultancy services, providing training facilities, making field studies, testing, standardization, etc. were mentioned. The importance of pilot plants and demonstration units for the successful transfer of research results to industry was mentioned. Such policies as were being implemented in countries like India and the Republic of Korea where transfer of R&D results to industry was relatively more successful. Mechanisms of regional co-operation, utilizing existing institutions like the Association of Science Co-operation in Asia (ASCA), ASEAN Committee on Science and Technology (COST), Regional Centre for Technology Transfer in the ESCAP Region (RCTT), etc. were mentioned. The importance of implementing joint projects as done by Scandanavian countries and OECD countries was stressed in the paper. The role of UNIDO and ESCAP for promoting transfer of research results from indigenous R&D institutions to industry in terms of recommendations made at earlier meetings organized was mentioned.

25. The paper presented by Dr. C.V.S. Ratnam stressed on the formation of networks among R&D institutions and small- and medium-scale industries and their linkages through the medium of UNIDO/INTIB for accelerating and increasing the flow of R&D results to industry, in view of large benefits network activities could offer to participants. A concept of a network was given. The paper, after briefly mentioning about activities of research and development organizations in developing countries of ESCAP region and the activities of the UN organizations like UNIDO, UNESCO, ESCAP/RCTT in the encouragement of the formation of networks for carrying out activities in specific technologies of interest

to countries of the region proposed.

26. The advantages of such network activities in terms of reduction in time for completing projects, weeding out unnecessary projects, reduction in costs for completing projects, better accessibility to R&D information inside and outside the countries, promotion of TCDC and ICDC, more efficient utilization of existing infrastructure facilities, strengthening linkages among R&D institutions and countries and promotion of self-reliance were mentioned. In proposing the networks, notice was taken of the fact that some countries had relatively a very large number of R&D institutions and in those countries the network had to function through focal points in each country. The paper mentioned about the necessity for supplying to R&D institutions information regarding needs of industry and the type of assistance industry required for successful establishment and operation of their units. The involvement of chambers of commerce and industry associations was proposed, in view of the fact that a large number of industrial units in the small- and medium-scale sectors were involved. The need for associating and establishing linkages with promotional organizations like technology transfer institutions, industrial development banks and link such arms as design, engineering and consultancy organizations was brought out in the paper. The paper gave the modalities for the working of the networks. Regarding finance for the operation of networks the paper proposed that countries and institutions bear in-country costs and UNIDO/INTIB external costs. The paper elaborated the initiatives that needed to be taken at the country level and at the institutional level, industry level and the UNIDO/INTIB level for the successful implementation of the programme for increasing the flow of R&D results to users.

27. The paper gave the approximate workload involved at the level of the institutions in the networks and the UNIDO/INTIB. Stress was made with regard to establishing a monitoring mechanism to help achieve objectives of the networks and the UNIDO/INTIB, entering into agreements with countries regarding implementation of network activities. The paper then gave the issues that needed to be discussed at the Workshop and the desirability of the formation of a network of R&D institutions during the course of the Workshop. UNIDO/INTIB was requested to take urgent action for the formation of the networks of small- and medium-scale industries and linking that network with that of R&D institutions. Follow-up activities that needed to be undertaken at the country level in terms of policy declaration, identification of institutions involved in the network and agreements to be entered into with UNIDO/INTIB and at the institutional level regarding the network modalities, nominating officials to carry out the network activities and creating the atmosphere for carrying out these and at the UNIDO/INTIB for concluding agreements with countries working out, modalities with R&D institutions, promotional organizations and link institutions, organization of a monitoring activities and strengthening their in-house capabilities were mentioned.

28. Mr. R.M. Notosuwarso of ESCAP made a presentation on the ESCAP Plan of Action on Technology for Development. He mentioned that as a follow up of the Vienna Programme of Action on Science and Technology for Development, which was adopted at the Vienna UN Conference on Science and Technology for Development in 1979, the ESCAP fortieth session of the Commission held in Tokyo in April 1984 had the theme, Technology for Development.

29. Discussion at the ESCAP fortieth session resulted in the member countries adopting the ESCAP Plan of Action whose main focus was on the establishment of co-operative and/or tripartite activities in:

(i) Research, development and demonstration projects in selected areas of technology;

(ii) Efforts to identify technological needs, capabilities and levels of technological development in the relevant areas aiming at the publication of a Technology Atlas, as feasible;

(iii) Finding practical ways of sharing information;

(iv) Promotion of regional co-operative activities for the creation of a favourable technological climate;

(v) Initiating measures for the technological development of the least developed, land-locked and island developing countries

30. This Plan of Action was formulated with the main objectives of iimproving self-reliance in technological development and promoting national, sub-regional and international co-operation in the utilization of technology for social and economic development in the ESCAP region.

31. The Plan reiterated and re-emphasized that for the success of any national action plan political commitment at the highest level involving financial and administrative commitments were of vital importance. The document enunciated the role of ESCAP in the implementation of the plan.

IV. SUMMARY OF COUNTRY PAPERS

32. Two sessions were devoted to the presentation of country papers.

PAKISTAN

33. Mr. M.A. Dahir of Pakistan focussed his discussion on the diverse elements which influence in maximising commercialization of research results, but which had not yet been adequately developed in Pakistan. He especially emphasized the need for adoption of fiscal and monetary incentives for the commercialization of research results. He outlined some proposals to alleviate difficulties in commercialization of research results.

34. Mr. Mahboobul Hasan of Pakistan, in his paper, explained that most of the research and development (R&D) activities in Pakistan were undertaken by Government-controlled agencies. But these organizations suffered from many constraints such as lack of funds, skills, effective linkage mechanisms, etc. The Government of Pakistan had, therefore, set up National Commission for Science and Technology (NCST) and intend to give various incentives to fill technological gaps and to promote R&D activities in the country. NCST had taken effective steps to implement these, as a result of which major industrial units had set up in-house units to undertake R&D activities. Pakistan had to attend to its R&D needs far more aggressively, yet selectively. It cannot afford to fritter away its limited resources and energies on entering basic research in all fields and sectors. At the same time, it cannot neglect the scope of original and essential research which the country's industry, agriculture and other sectors call for in order to provide dynamism and competitiveness to its overall economic development.

MALAYASIA

35. The joint paper prepared by Dr. M. Mansor Salleh of SIRIM and Mr. Chan Yuen Hung of Ministry of Science, Technology and Environment, Malaysia, was presented by Dr. Mansor Salleh.

He explained that the majority of the government-funded R&D institutes in Malaysia were involved in research to increase the yield and quality of agriculture crops such as rubber, palm oil, etc. The results of these research projects and the effective transfer of know-how through extension and consultancy services had assisted in the achievement of Government's objective to diversify and expand the agricultural base of the country. In the last sixties and seventies, however, there was a shift in the emphasis of the country's economic strategy from agriculture to that of industrialization especially, for import-substitution and agro-based industries. Responding to this change, Malaysian research institutes oriented their projects to emphasize applied and agro-based research. It was realized that the extension and consultancy services offered by research institutes were not adequate for effective transfer of research results to industry and the concept for commercialization of research results had to be seriously looked into. These were examined in detail by the Ministry of Science, Technology and the Environment and SIRIM was given the pioneering task of establishing a mechanism within the institute for this purpose. It is hoped that this would lead to similar mechanism being set up in other institutes.

36. Several steps had since been initiated by the Government to emphasize the need to concentrate on applied research and technology transfer such as:

(i) the formulation of a National Science and Technology Policy,

(ii) the establishment of a Patent Information and Documentation Centre in SIRIM as a basis for the establishment of a National Technology Information Network,

(iii) the recognition of the need to set up a Technology Transfer Centre,

(iv) the establishment of an indigenous industrial intellectual property system.

NEPAL

37. Mr. L.N. Khanal of Nepal pointed out that R&D carried out in Nepal was at a relatively modest. But even then, many entrepreneurs were not able to avail of this low cost technology. In other cases undue pressure was brought about to adopt a specific technology. He, therefore, emphasized the need for information sharing, to choose from amongst diverse available technologies. Further, commercialization of research results had been circumscribed by lack of a coherent national technology policy. He described the legal framework created recently in Nepal through the Industrial Enterprises Act and the Foreign Investment and Technology Act for systematically effecting the transfer of technology from abroad. He also urged linking up of national and international knowledge bases to optimise the outcome of the research undertaken not only at a national level but also that by other countries.

REPUBLIC OF KOREA

38. Speaking on the Government Policy in Korea, Mr. Young Jung Kim outlined the diverse measures and policy instruments available in Korea to encourage development efforts of private industry, the semi-governmental research institutes and the university community. In this context, he described the promotion of R&D through tax reduction measures, financial support for key areas of R&D and assistance for commercialization activities, etc. He also described the activities of venture capital and venture businesses recently established in Korea. Specifically, comparisons were made as to the different activities of K-TAC, KTDC, KDIC and KIFC. He stressed that more commercializable R&D results were required to derive the full benefit of the available venture capital funds. He also mentioned about liberalization in procedures for import of technology recently. It was believed that this liberalized policy would ultimately lead to strengthening of Korea's R&D capability.

39. In describing the Korean experience, Mr. Young-Ok Ahn outlined the function and performance record of K-TAC. While K-TAC's primary function was to commercialize research results emanating from semi-governmental research institutes such as KAIST, K-TAC was also attempting to introduce relevant technology through joint ventures with advanced countries. In this, K-TAC could share its experiences and business ideas with other developing countries. He mentioned about 11 commercial ventures created by K-TAC and the know-how licensed to industry. New companies promoted by K-TAC with business entrepreneurs could obtain funds from development finance institutions such as KLB, KTDC and KDIC with greater ease than otherwise. It was expected that K-TAC would continue its vital role of linking R&D community with the industry.

SRI LANKA

40. In his paper Dr. A.N.S. Kulasinghe from Sri Lanka stressed that commercialization of R&D results was a difficult task; more difficult than the R&D work itself. The strategy for commercialization depended on the type of product or process as enterprises using R&D results would not get quick profits.

41. The economic situation in Sri Lanka had necessitated availing of foreign assistance which was normally accompanied by certain conditions. These hampered endogenous R&D and the commercialization of R&D results became more difficult. Most R&D institutions in developing countries were state-owned and therefore lacked sufficient commercial interest.

42. Commercialization of R&D results required the establishment of certain links with industry. Consultancy could provide such links. Some institutions carried out certain statutory functions which also helped to establish effective links with industry. Besides, entrepreneur's interest had to be created by involving them with the activities of the institutions as far as possible.

43. A case study of a simple lighting system was presented to illustrate some of the problems and solutions. The strategy used had resulted in the commercial success of the project.

44. Some guidelines for the requirement of a National Technology Policy was given in the paper. Regional co-operation among developing countries was useful. But co-operating partners had to be chosen with care. Technology could be and should be the prime motive force of development rather than being a passive follower.

45. Mr. M.S. Wijeratne also of Sri Lanka outlined the scope and activities of Ceylon Institute of Scientific and Industrial Research (CISIR). He then described the conditions under which technologies developed at CISIR were made available for commercialization. The results of a research project commissioned and paid for by a client became the exclusive property of that client. Government directives required that technologies developed through CISIR in-house projects be advertised and be awarded to the highest bidder on a non-exclusive basis. Some of the problems encountered in following these directives were discussed. Some of the malpractices engaged in by technology buyers and the difficulties in preventing them from doing this were also mentioned. Past experience had made the Institute search for an industrial partner in carrying out pilot plant trials. Three case studies were presented. These described the factors which helped technologies to be successfully commercialized. Failure in commercializing the third technology which had shown much promise was attributed to lack of understanding of the special nature of the market for the product.

46. He emphasized that a project which did not result in commercialization could not be termed a failure since a good deal of knowledge and/or useful experience could result from such a project.

PHILIPPINES

47. Dr. Filemon A. Uriarte, Jr. of Philippines pointed out that the National Institute of Science and Technology (NIST) was the oldest research institute in the Philippines. Established in 1901, it had today a staff of nearly 600. In spite of its long history and its moderate success in scientific research and technological development, its success in technology transfer was limited. Among the few successful efforts on record were: the technology for extracting from rice polishing a thick syrup that prevented beri-beri, in the 1920s; the upper leather processing technology, in the 1930s; the canned coconut milk technology, in the 1970s; and the coconut expeller technology, in early 1980s.

48. The biggest problems in technology transfer appeared to be lack of direct linkage between existing industries and the research institutes and the lack of credibility of the research institutes. To establish credibility, research institutes must show that they were capable of producing technologies that could be successfully commercialized. Initially, the institutes must minimize the possibility of failure by making sure that: (i) the technology being transferred was mature and sufficiently proven, (ii) a market existed for the product; and (iii) the recipient was sincerely interested in the exploitation of the technology and had the organization, capital and capabilities to support the technology transfer process, and a marketing network to distribute the product.

49. Following these guidelines, the NIST was presently transferring 5 technologies to existing and viable industries: an improved alcohol fermentation technology using highly flocculating yeast fusart; accelerated fermentation process for producing premium quality soy sauce;improved solar salt making technology; technology for producing essential oils from local plants; and new technology for the production of coconut water

beverage. The firms represented a cross-section of Philippine industry: from a small pharmaceutical firm, to medium and large food manufacturing companies, to a very large corporation. Initial results indicate that the technology transfer would be successful.

50. Contract research with the private sector had been and will be intensified since it provided a mechanism for the immediate transfer and commercialization of research results. The NIST had already started activities for this purpose and would continue to develop and transfer technologies in accordance with the "demand-pull" policy in science and technology.

INDONESIA

51. Mr. G.P. Sudirjo from Indonesia indicated that the commercialization of industrial research results in Indonesia had not progressed very far yet. This was due to the fact that no close relationship existed between the Government research institutions and industry, which was the result of the Government laws and regulations not allowing Government institutions to accept contract research, lack of adequate promotions, and financial constraints. Also lack of trust and unwillingness of large and medium scale industry to use domestic research results, especially those with foreign joint undertakings, who were receiving technology from their parent companies abroad, were also hampering the development and commercialization of domestic research results. From the case studies mentioned, he concluded that active involvement and participation of the Government as well as a captive and continuous market would ensure successful commercialization.

52. To cope with these bottlenecks, a better environment for commercialization of research results should be established, i.e. by introducing national policies or regulations to ensure close relationship between the research institutions and industry, incentives to research institutions

as well as industry who were willing to commercialize indigenous research results, and also strengthening and improving the capabilities of the research institutions themselves.

53. A regional network where information and experiences could be shared and exchanged, besides organizing of tailor made programmes and workshops would help to improve the commercialization of domestic research results.

INDIA

54. Dr. H.R. Bhojwani of India stressed that industry was just one amongst the many beneficiaries of R&D carried out by S&T research institutions in India. Industry derived benefits from the research activities of these institutions in diverse ways, licensing of know-how being just one of these. Thus, judging the performance of these research institutions on the basis of their 'licensing activities' alone was not correct. The use of laboratory research results by an industrial enterprise in a developing country was vastly different from the use of technology acquired from another industrial unit established abroad. The former involved high risk and required technological maturity. Both these qualities were scarce among the entrepreneurs in developing countries as compared to their counterparts in developed countries.

55. Small and medium entrepreneurs were the main users of domestic laboratory research since they lacked the resources to acquire technology from abroad and therefore had to seek it from within the country. There was thus a mismatch between domestic research results and their potential users. The four case studies presented showed that the closer the R&D got to commercial/field proving of technology, the greater was the probability of success. The case studies also showed that government's support and protection to domestic laboratory

technology against import of technology was necessary to ensure its success.

56. He also explained about the new technology policy announced by the Government of India which would promote indigenous technology development and utilisation. This technology policy had also favoured co-operation between developing countries at regional level for achieving collective technological self-reliance.

THAILAND

57. Dr. Santhad Rojanasoonthon of Thailand, in his paper, outlined the position of commercialization of R&D results in his country. In most cases developing countries do not have sufficient technological structure and personnel to develop, digest and improve the technology as well as carry it through to production stage. Lack of funds, market analysis, efficient management, and expertise in many fields made commercialization more difficult. Imported R&D results and technology need to be retained through proper transfer mechanism which will assist in industrialization of the products. Stronger and concerted effort of government and private sector were needed to build up R&D results that have good potential and process them through to production stage.

58. Some of the R&D results such as garlic powder or electronic parts for micro-wave may have been successful in production but simple and in great demand nursery block for reforestation may fail miserably due to lack of quality control and effective management. Assistance through joint venture may help successful commercialization and good linkage with industry. Information, new improved technology and money are important means of linking IRSI and industry.

59. In Thailand, the popularization of S&T prompts the initiative to revamp the direction to be taken by TISTR in order to attain capability leading to credibility with industry through meaningful R&D and services. It may not be too far-fetched to aim at rich, prosperous sturdy and strong nation with self-reliance which is able to keep abreast with the developed world.

60. The papers presented at the Workshop is in Annex-III.

V. GROUP REPORTS

Group I - National Technological Policies regarding Commercialization of Research Results

Participants:

1.	Mr. A.N.S. Kulasinghe	Sri Lanka	Chairman
2.	Mr. Mahboobul Hasan	Pakistan	Rapporteur
3.	Mr. Chan Yeun Hung	Malaysia	
4.	Mr. Leela Nath Khanal	Nepal	
5.	Mr. Young Jung Kim	Republic of Korea	
6.	Mr. Garjito Pringgo Sudirjo	Indonesia	
7.	Mr. Surapol Chivasutho	Thailand	

1. The Group discussed in detail conditions prevailing in most developing countries with regard to R&D activities particularly, for commercialization of research results and national science and technology policies and their impact on the various sectors of economy. The Group considered the views of all the participants, which they had expressed through their papers presented to the Workshop on 15th and 16th October 1984. The Group also made an in-depth study of ESCAP Plan of Action on the "Technology for Development in Asia and the Pacific" presented in its Tokyo session in April 1984 and two background papers prepared by UNIDO consultants, namely one by Mr. F.N. Woodward titled UNIDO Background/issue paper and the other by Dr. C.V.S. Ratnam titled Networks and Related Initiatives for Increasing Flow of Information and R&D Results among R&D Institutions and Between them and Small and Medium Scale Industries in Developing Countries of ESCAP region.

2. The Group noted that most developing countries either did not have an adequate set-up to undertake R&D and if the did, these were mostly

government controlled or aided agencies. The effectiveness of such organizations was greatly impaired due to basic weaknesses such as: inadequate organizational structure; lack of finances; low level of technical skill; lack of fiscal and monetary incentives and lack of policy support for promotion of research; and elements of aspect of commercialization of research results missing or visible in a very limited way.

3. In view of the above, the Group felt that there was an urgent need for each developing country to formulate such policies which would not only give impetus to its economic growth but also establish a meaningful and permanent technological base in the country. Towards this objective countries should evolve promotional policies for R&D which not only helped existing industries but also played their rightful role in the development and commercialization of products and processes based on indigenous R&D. In this connection the Group benefitted from Korean experience, its S&T policies, the role of KAIST and K-TAC in commercialization of R&D results for medium and small scale industries and the incentive systems persued by them for the successful implementation in their R&D programmes.

4. Considering the above and after deliberating extensively on the subject the Group recommended the following:

4.1 Each country should provide adequate funds to its science and technology institutions to enable them to undertake R&D.

4.2 The research organizations should undertake goal oriented research.

4.3 Owing to lack of co-ordination and communication between various national research institutions, their research efforts did not often achieve the desired goals. A proper mechanism for co-ordinating such activities should be established by each developing country.

4.4 National policies should aim at using the locally developed know-how to the maximum extent. This can be done by providing incentives to users of indigenous R&D results and from institutions in other developing countries through easy availability of foreign exchange, tax write offs, etc.

4.5 Financial institutions should provide concessional finance to support not only research but also subsequent implementation of development projects based on such research.

4.6 National fiscal policies should encourage the undertaking of R&D by industry through measures such as:

- tax incentives;
- exemption from levy of customs duty etc. on import of machinery and equipment, components and raw materials needed for R&D activities.

4.7 Each country should take steps to reduce the risk borne by its entrepreneurs in pioneering the use of domestic of research results.

4.8 Research institutes should pay due attention to manpower development programmes particularly, for marketing of R&D results.

4.9 In-house groups should be established in R&D institutions to evaluate R&D results, prior to making them available to industry.

4.10 Developing countries should set up organizations, similar to NRDC of India and K-TAC of Korea which were essential for up-scaling and transfer of R&D results to users.

4.11 A Central Advisory Committee be set up in each country to evaluate and screen technology sought to be imported for its suitability for adoption under local-specific conditions.

4.12 Local R&D institutions should be involved in the process of transfer of imported technology to ensure the effectiveness of transfer and for its absorption and improvement.

4.13 To ensure smooth flow of information, data banks (centres) should be set up in chambers of commerce and industry and R&D institutions utilizing modern facilities and techniques of data processing.

4.14 Industry should promote research in R&D institutions through financial support and participation in setting up pilot plant and for producing prototypes.

4.15 R&D results should be publicized not only through technical literature but also through mass media instruments such as 'press', radio, T.V., film etc.

4.16 At the national level mechanisms should be instituted to monitor the progress and problems, and provide the inputs to facilitate the flow of R&D results to users within and outside the country.

5. The Group emphasized the importance of co-operation between countries, and of R&D instituions within these countries for carrying out joint programmes. This would enhance the flow of R&D information and stimulate commercialization of R&D results both nationally and internationally.

UNIDO/ESCAP could play an important role in commercialization of research results of IRSIs by:

- encouraging regular contacts between IRSIs in the region,
- arranging at regular intervals similar workshops as the present one,
- helping member countries to carry out regional co-operative research programmes,
- preparing, in collaboration with other international organizations, a guide on experiences in the commercialization of research results,
- assisting member countries in setting up networks, information systems, training programmes, evolving R&D policies, mechanisms for financing the commercialization of research results and linkages between IRSI in developing and advanced countries.

6. Finally, the Group endorsed the views given in the Vienna Plan of Action and the ESCAP Action Plan regarding follow up activities for the implementation of recommendations made during the Workshop and strongly urged the national governments to implement the activities suggested by the Workshop.

Group II - Linkages between Industrial Research and Service Institutes and Industry

The following participants took part in Group II discussion:

1.	Mr. Young-Ok Ahn	Republic of Korea	Chairman
2.	Mr. Mohammad Mansor Haji Salleh	Malaysia	Rapporteur
3.	Mr. Masood Ahmed Dahir	Pakistan	
4.	Mr. M.S. Wijeratne	Sri Lanka	
5.	Mr. Filemon Uriarte	Philippines	
6.	Mr. H.R. Bhojwani	India	
7.	Mr. Santhad Rojanasoonthon	Thailand	
8.	Miss Pattra Lapikanon	Thailand	
9.	Ms. Sachee Piyapongse	Thailand	
10.	Ms. Wilawan Ritruechai	Thailand	

1. Members of the Group discussed some of the problems and weaknesses present in the system of commercialization of research results especially the linkages between R&D organizations with industry.

The major problems encountered were:

1.1 Lack of liaison between R&D institutions and industries resulting in industries not being fully aware of the work of the R&D organizations and the latter not grasping fully the needs of industry.

1.2 Releasing inadequately evaluated development projects thereby causing hardship in their commercialization by industry.

1.3 Lack of adequately trained manpower in R&D institutions leading to loss of credibility of these institutions to transfer technology to industry.

1.4 Lack of venture capital to promote the commercialization of unproven technologies resulting in many technologies not being exploited.

1.5 Lack of exchange of information between organizations at intra-national and international levels.

2. After discussions, the Group recommended the following to strengthen linkages between industrial research organizations and industry and to promote greater flow of R&D results to users.

2.1 In order to establish from linkages between R&D organizations and industry a programme for exchange of personnel between industries and R&D organizations should be promoted. This would succeed only when persons from R&D organizations and industry are involved in its planning and implementation.

2.2 Liaison units should be set up in all R&D organizations to help establish linkages with industry, other research bodies including the universitites, international organizations and the public at large. To maintain these links, some staff of the liaison units may be seconded from industry on a regular basis to R&D organizations and vice versa

2.3 An integrated information network should be set up within the R&D organization to undertake selective dissemination of information to industries. This would greatly assist in getting projects from industries.

2.4 A regional R&D information network in the ESCAP region should be set up to supply up-to-date information on R&D organizations and their commercialization activities to member countries. Member organizations should exchange information on research topics with short abstracts, annual reports and personnel with a view to upgrade their research capabilities. International organizations such as UNIDO may be requested to help establish the network, link it up with networks of user industries and promote the activities of the network. Also national linkages must be set up within member countries of ESCAP to be followed up by a comprehensive regional linkage system. Financial assistance for these activities should be obtained from funding organizations like UNIDO/INTIB in the UN system and outside organizations.

2.5 In order to foster linkages with the users, industries should be encouraged to fund projects on a joint venture basis with R&D institutes. Financial policies of the countries should encourage these linkages through such systems as matching funds.

2.6 To ensure availability of risk capital, venture capital companies should be set-up to finance establishment of industry based on indigenous R&D work. Links between R&D organizations, venture capital companies and financial institutions should be institutionalized.

2.7 National policies should encourage industrial enterprises to establish in-house R&D activities in order to facilitate transfer of results from R&D institutions to industry.

2.8 In order to create awareness of R&D activities, national research bodies should organize, in collaboration with industry and trade associations, training programmes and courses at all levels.

2.9 To further strengthen intra-regional linkages and improve capabilities of R&D institutions in ESCAP developing countries for technology transfer, appropriate training should be organized by specialized institutions within the region, if need be with UNIDO assistance.

ANNEX I

WORK PROGRAMME

Monday, 15 October 1984

09.00-10.00	- Opening ceremony Welcome address by Dr. Santhad Rojanasoonthon, Deputy Governor, TISTR Welcome speech by Dr. V.J. Ram, Chief, ESCAP/UNIDO Division of Industry, Human Settlements and Technology and Officer-in-Charge for the Executive Secretary of ESCAP Welcome speech by Mr. M.A. Siddiqui, Special Representative of Executive Director of UNIDO to ESCAP Welcome speech by UNDP Assist Regional Representative, Ms. S. Natsume Inauguration speech by Mr. Kasem Snidvongs, Deputy Permanent Secretary of State, Ministry of Science, Technology and Energy
10.30-12.30	- Election of the Chairman/Rapporteur - Presentation of UNIDO and ESCAP Background Papers - Presentation of participants' papers/case studies
14.30-17.00	- Presentation of participants' papers/ case studies continue - Questions and answers - Discussion

Tuesday, 16 October 1984

08.30-09.30	- Presentation of participants' papers/case studies - Election of the Group Chairmen/Rapporteurs

10.00-12.30 - Group discussion

Group I: National technology policies regarding commercialization of research results

Group II: Linkage between IRSI and industry

14.30-17.00 - Group discussion continue

Wednesday, 17 October 1984

09.00-12.30 - Preparation of Working Group draft reports

14.30-17.00 - Plenary session: presentation of Working Groups I & II draft reports and discussion

Thursday, 18 October 1984

09.00-12.30 - Plenary session: Preparation of draft report

14.30-17.00 - Plenary session: discussion on draft report

Friday, 19 October 1984

09.00-12.30 - Study tour of TISTR

14.30 - Consideration of conclusions and recommendations

- Adoption of report

- Closing ceremony

ANNEX II

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ANNEX III

LIST OF DOCUMENTS AND COUNTRY PAPERS

1.	Aide-memoire	
2.	ID/WG.435/1	The National Institute of Science and Technology: Development and Transfer of Technology - by F.A. Uriarte, Jr.
3.	ID/WG.435/2	Commercialization of Research Results of Nepal - by L.N. Khanal
4.	ID/WG.435/3	Commercialization of Research Results: Thailand Experience - by S. Rojanasoonthon
5.	ID/WG.435/4	Commercialization of Research Results in particular Reference to Engineering Sector of Pakistan - by M. Hasan
6.	ID/WG.435/5	Commercialization of Industrial Research Results in Indonesia - by G.P. Sudirjo
7.	ID/WG.435/6	Commercialization of Research Results: Issues and Solutions of Pakistan - by M.A. Dahir
8.	ID/WG.435/7	Commercialization of Research Results at National Level including Linkaging Mechanism between Industrial Research Institutions and Industry of Sri Lanka - by M.S. Wijeratne
9.	ID/WG.435/8	Commercialization of Research Results of Sri Lanka - by A.N.S. Kulasinghe
10.	ID/WG.435/9	Commercialization of Research Results in Malaysia: A National Perspective - by Mansor Salleh and Y.H. Chan
11.	ID/WG.435/10	Commercialization of Research Results: Government Policy of Korea - by Y.J. Kim
12.	ID/WG.435/11	Commercialization of Research Results: Korean Experience by Y.O. Ahn
13.	ID/WG.435/12	Commercialization of Research Results of Research Institutions in the ESCAP Region (UNIDO Background/Issue Paper) - by F.N. Woodward
14.	ID/WG.435/13	Commercialization of Research Results Experience and Some Case Studies of the Council of Scientific and Industrial Research of India - by H.R. Bhojwani
15.	ID/WG.435/14	Networks and Related Initiatives for increasing Flow of Information on Research and Development Results Among Research and Development Institutions and Between them and Small and Medium Industries in Developing Countries in ESCAP Region (UNIDO Background/Issue Paper) - by C.V.S. Ratnam